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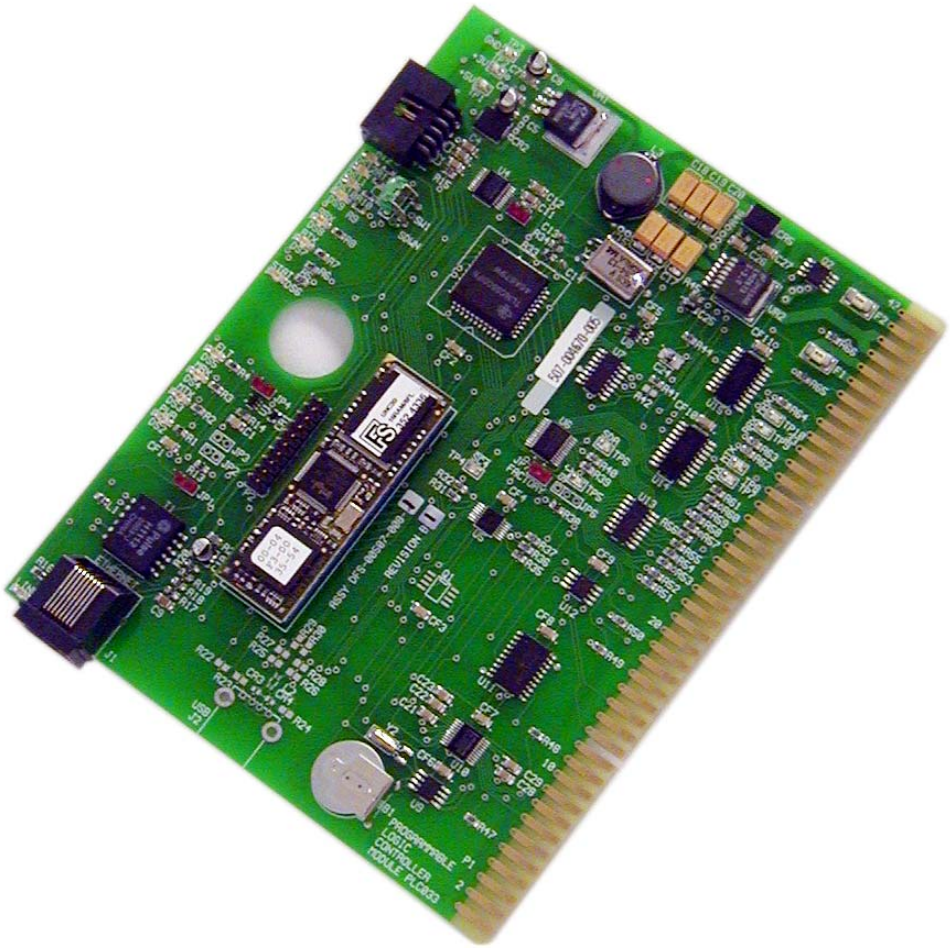

PLC033

INSTALLATION & OPERATION MANUAL

PLC033
INSTALLATION AND OPERATION MANUAL

© Data Flow Systems, Inc.
605 N. John Rodes Blvd., Melbourne, FL 32934
Phone 321-259-5009 • Fax 321-259-4006

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Data Flow Systems also reserves the right to make changes to the specifications of the PLC033 Programmable Logic Controller and to the information contained in this document at any time without notice.

DFS-00507-011-01

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PURPOSE OF THIS MANUAL

This manual is a reference guide for installing, programming, and operating the PLC033 programmable logic controller (DFS-00507-008-01). It contains information meant to guide and assist you through installation, configuration, and programming procedures. This includes mounting and wiring instructions, product features and specifications, I/O listings, instructions for integrating with telemetry, and information on configuring communication and I/O properties, programming the PLC using ladder logic, and creating custom user interface screens.

DOCUMENT CONVENTIONS

The following conventions are used throughout this manual:

- Bulleted lists provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchal information.
- *Italic* type is used for emphasis

ORGANIZATION

- Chapter 1: Product Overview – Provides a brief description of the PLC033 along with a list of features, specifications, and pin descriptions.
- Chapter 2: Before You Begin – Discusses safety measures that should be taken when working with the PLC033.
- Chapter 3: Principles of Operation – Presents information on how the PLC033 operates, including a discussion of serial and network interfaces, I/O mapping, ladder logic, and customized user interfaces.
- Chapter 4: Getting Started – Outlines the steps required when setting up a system.
- Chapter 5: Hardware Installation – Provides information on installing the PLC033 in an RTU and wiring RS-232/-485 and network devices. Also discusses the use of a PLC By-Pass card.
- Appendix A: Testing and Troubleshooting – Discusses how to test and troubleshoot radio and network communication problems.
- Appendix B: Application Notes – Describes how the PLC033 can be used to solve specific problems.
- Appendix C: Update PLC Firmware – Gives instructions on updating the PLC's firmware ((the ROM-based software that controls the device).
- Appendix D: Parts List– Provides a list of products available for use with the PLC033.
- Appendix F: Support, Service, and Warranty – Gives information on how to obtain support and service from Data Flow Systems, Inc. The warranty statement is also provided here.

ABBREVIATIONS USED IN THIS MANUAL

ACM – Analog Control Module

AMM – Analog Monitor Module

I/O – Input/Output

BEM – Bus Extender Module

DCM – Digital Control Module

DMM – Digital Monitor Module

LSB – Least Significant Bit

MBP – Modular Backplane

MSB – Most Significant Bit

NIM – Network Interface Module

PLC – Programmable Logic Controller

PMT – Process Management Toolkit

RIM – Radio Interface Module

RIO – Rail I/O (RIO128 with 128 I/O; RIO032 with 32 I/O)

RTU – Remote Terminal Unit

Chapter 1: PRODUCT OVERVIEW

DESCRIPTION

The PLC033 is a microprocessor-controlled programmable logic controller designed for implementing local logical control at the RTU via an installed ladder logic program. Users configure the PLC033's I/O and communication settings and create the ladder logic program using the applications included in the supplied Process Management Toolkit (PMT) software.

The PLC033 must be installed in a specially-designed RTU – one with a modular backplane (MBP) that has been modified to split the communications bus into two entities: the Radio Bus and the Module Bus. The MBP is a printed circuit board composed of card edge connectors for the modules, module bus circuitry, and a connection for the back-up battery. The PLC033, and all other DFS plug-in function modules used in the system, are plugged into card edge connectors mounted on the RTU's MBP.

In a typical installation, the PLC033 is installed between the RIM (Radio Interface Module) and up to 15 DFS function modules. The PLC033 uses the Radio Bus to communicate with the RIM and the Module Bus to communicate with the DFS function modules. Once installed in the RTU, the PLC033 communicates with configured DFS function modules over the Module Bus, getting their status and updating their outputs according to the ladder logic program. It communicates with the central site via the RIM interface, relaying status and control information. It can also simulate "logical" analog and digital modules to allow the PLC033's program to interact with the SCADA system.

The PLC033 can emulate up to two RTUs. This allows developers to exceed the 15 module maximum for DFS RTUs. This is accomplished by adding a remote device to PMT's Radio Map and configuring the remote device (station) in HyperTAC II. Refer to the Process Management Toolkit User Manual.

The PLC033 features an Ethernet port and a serial port (either RS-232 or RS-485) that can be used to expand the PLC033's functionality.

In addition to being the PLC033's programming interface, the Ethernet port enables the PLC033 to function as a network slave device using either DFS NIM RTU protocol or Modbus TCP protocol.

As a DFS NIM RTU slave, the PLC033 can be polled by a HyperTAC II central over the network. This feature can be used simultaneously with radio polling, so that one RTU can be polled from two different systems: one on the network and one over the radio link. Alternatively, the PLC033 can function solely as a network device by placing an RS-232 RIM (RIM board without the radio installed) in the RTU and polling the PLC033 from the HyperTAC II central using the DFS NIM protocol. There is no additional configuration required to implement either of these functions.

As a Modbus TCP slave, the PLC033 can be polled by any Modbus-compatible software that uses the Modbus TCP protocol.

Using the COM1 serial port, the PLC033 can function as a Modbus RTU/ASCII master or slave device. As a Modbus master, the PLC033 can poll a single Modbus-compatible RS-232 device, or multiple Modbus-compatible RS-485 devices via its COM1 serial port using either the Modbus RTU or ASCII protocol. As a Modbus slave, the PLC033 can be polled by any Modbus-compatible software that uses the Modbus RTU or ASCII protocols.

Another important feature of the PLC033 is its ability to function as a PLC central. The PLC Central feature enables the PLC033 to poll remote DFS RTUs in addition to local modules and local Modbus-compatible I/O. PLC Central can be a secondary function of the PLC033 or its primary function. The PLC033's mode is determined by the value of Special Function Register 9951, "Comm 2 DFS Central Mode." When the register is true, the PLC033 functions as a PLC central.

As a secondary function (limp, or backup, mode), the PLC033 can temporarily switch to PLC Central mode when it determines that communications with the HyperTAC II central have been lost. This mode uses two timers that are inserted in the PLC033's ladder logic program that instruct the PLC033 when it should switch to PLC Central Mode (Comm 2 DFS Central Mode is set to "true") and when it should return to normal operation (Comm 2 DFS Central Mode is set to "false") to check if communications with the HyperTAC II central have been restored.

For RTU systems that require a centralized site for logic, but aren't large enough to warrant a HyperTAC II central site, the PLC033 can be forced to permanently stay in PLC Central mode by setting and keeping the Comm 2 DFS Central Mode register at a "true" value in the PLC033's ladder logic program.

FEATURES

- 33 MIP ARM processor with 8M of Flash ROM and 16M of RAM
- 1200 or 9600 baud communications with TAC II devices
- Up to 38.4 Kbps with external RS-232/RS-485 devices using Modbus RTU or ASCII protocol
- PLC Central functionality
- Modbus TCP and DFS NIM RTU-based communications via Ethernet interface
- Real time clock for time of day functions
- Monitors its own power source and saves accumulated data when a power failure is detected
- Communicates with master or slave devices via serial port that can be used in RS-232 or -485 mode
- Programmed using ladder logic (Logic Builder); Program stored in Non-Volatile memory
- Communication and I/O parameters configured with user-friendly interface (I/O Builder)
- Custom status and control screens can be created using supplied software (Screen Builder)
- Shutdown button enables graceful shutdown of all PLC033 processes
- Surge protected (nondestructive)
- 4 programmable LEDs and 8 hardware/firmware-controlled LEDs (power, module receive data, module transmit data, radio receive data, radio transmit data, CPU failure, PLC033 status, and network status).
- On-board communications and functional firmware
- On-board voltage regulation
- Automatically retrieves data from modules on RTU bus
- Module is removable without disturbing field wiring
- Keyed to prevent damage
- Time-tagged messages
- Battery-backed clock/calendar synchronized by telemetry
- No adjustments, switches or straps (self-configuring)
- Watchdog timer
- Gold edge connector fingers

TECHNICAL SPECIFICATIONS

Board size	5.25” X 6.88”
Supply voltage	8 to 13 VDC
Supply current	290 mA
Max. number of DFS modules supported	15
Network Interface (1)	10/100base-T
Serial Interface (3)	COM1 (RS-232 or RS-485 Modbus master or slave); COM2 (DFS Radio Bus slave); COM3 (DFS Module Bus master)
LEDs	Four programmable LEDs (DS9, DS10, DS11, and DS12); 8 hardware/firmware-controlled LEDs: power (PWR), module receive data (MRX), module transmit data (MTX), radio receive data (RRX), radio transmit data (RTX), CPU failure (FLT), PLC033 status (STAT), and network status (LINK)
Configuration bits	Five configuration bits for use in ladder logic programs
Protocols	DFS, Modbus ASCII, Modbus RTU, and Modbus TCP

PLC033 INTERFACE

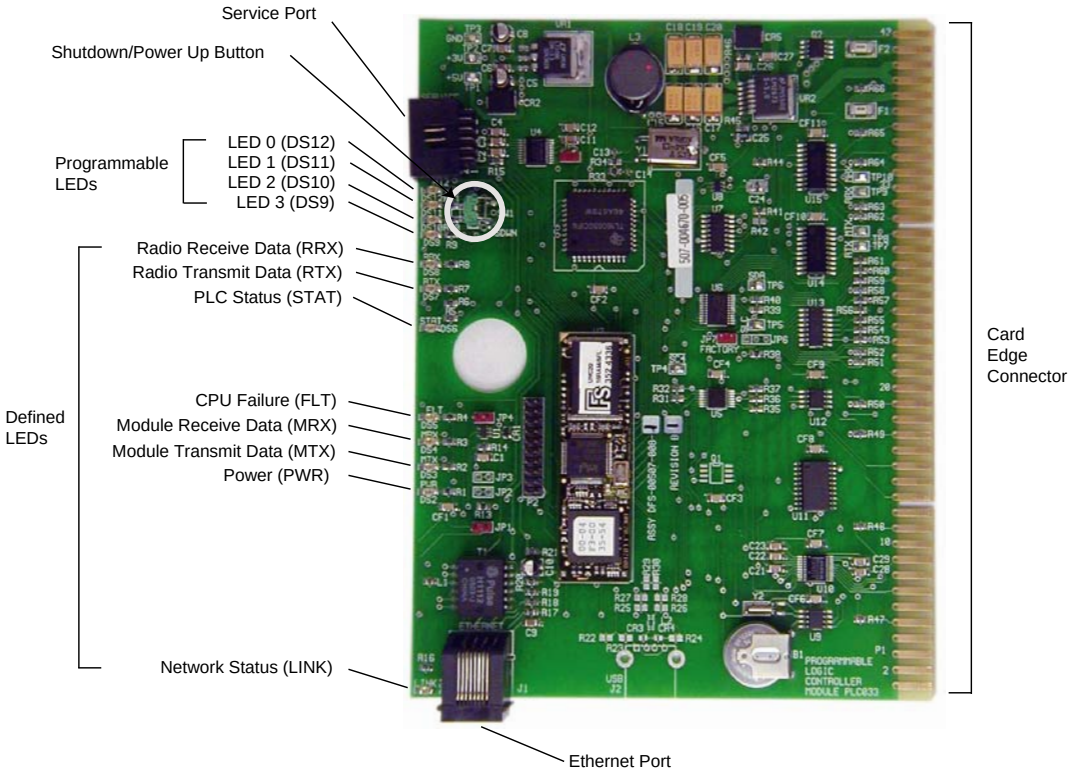


Figure 1-1, PLC033 Interface

RESERVED SET POINT REGISTERS

Blocks of registers in the DO and AO ranges are reserved for storing user set point values. Values stored in these registers are automatically written (saved) to the PLC's flash memory every 30 seconds. They are also saved during a controlled shutdown.

- During a controlled shutdown (see next section), user set point values are written to the PLC033's flash memory. These stored values are loaded when the process resumes.
- In the event of an abrupt loss of power, the process will use the values written to the PLC033's flash memory during the last automated save.

The following registers are reserved for set point values:

- Registers 9800-9899 are reserved in the DO range.
- Registers 49800-49899 are reserved in the AO range.

CONTROLLED SHUTDOWN

The following events initiate a controlled shutdown:

- If voltage in the panel falls to 11.2 volts, the PLC033's operating system will initiate the shutdown without user intervention.
- Press the shutdown button on the PLC033 to manually stop the process.
- Use Special Function Registers – Remote Process Start Command (9920) and Remote Process Stop Command (9921) – to shutdown the process from a remote location. For example, you could map these registers to a DFS module point in the PLC's DFS Radio Map and configure the same point in HT3. The registers could then be controlled from a custom screen or a default screen.

SPECIAL FUNCTION REGISTERS

The following local and derived I/O points are provided as special function registers. Most of these registers are for external status queries. For example, registers 9930 (Remote Process Running) and 49902 (Maximum Ladder Loop Time) give you important information on the status of the PLC033. Others, such as 9900 (Configuration Bit 0) and 9910 (LED 0) can be used in ladders to control the behavior of the PLC033.

Table 1-1, Special Function Registers

Address	Function	Ladder R/W	Remote R/W
9900	Configuration Bit 0	R	R
:	:	:	:
9905	Configuration Bit 5	R	R
:	:	:	:
9909	General Input 9	R	R
9910	Led 0 DS12	RW	R
9911	Led 1 DS11	RW	R
9912	Led 2 DS10	RW	R
9913	Led 3 DS9	RW	R
9920	Remote Process Start Command	R	RW
9921	Remote Process Stop Command	R	RW
9930	Remote Process Running	RW	R
9940	Global Alarm	R	R
9941	Low Memory	R	R
9942	Low Voltage	R	R
9943	Local I/O Fault	R	R
9950	Comm 1 DFS Central Mode	RW	R
:	:	:	:
9957	Comm 8 DFS Central Mode	RW	R
49900	Local Analog Input (Power Supply Voltage)	R	R
49901	OS Free Memory	R	R
49902	Maximum Ladder Loop Time	R	R

Address	Function	Ladder R/W	Remote R/W
49903	Average Ladder Loop Time	R	R
49904	Minimum Ladder Loop Time	R	R
49905	Maximum I/O Loop Time	R	R
49906	Average I/O Loop Time	R	R
49907	Minimum I/O Loop Time	R	R
49908	Hardware Model	R	R
49909	Hardware Revision	R	R
49910	Software Version Year	R	R
49911	Software Version Month	R	R
49912	Software Version Day	R	R
49913	OS Version Year	R	R
49914	OS Version Month	R	R
49915	OS Version Day	R	R
49916	Serial Number High	R	R
49917	Serial Number Low	R	R
49918	Network Address Octet 4	R	R
49919	Ladder Process ID	RW	R
49920	Ladder Process Version Year	RW	R
49921	Ladder Process Version Month	RW	R
49922	Ladder Process Version Day	RW	R
49950	Comm 1 Time Since Last Comm (secs)	RW	R
:	:	:	:
49957	Comm 8 Time Since Last Comm	RW	R
49999	Remote Reset (data must be 0xA5A5)	R	RW

PLC033 PIN DESCRIPTIONS

LOCAL MODULES SYSTEM DC VOLTAGE +	43		
		42	RIM SYSTEM DC VOLTAGE +
LOCAL MODULES SYSTEM GROUND	41		
		40	RIM SYSTEM GROUND
LOCAL MODULES /POWER DOWN /	39		
		38	RIM /POWER DOWN /
LOCAL MODULES /REQUEST TO SEND /	37		
		36	RIM /REQUEST TO SEND /
LOCAL MODULES /CLEAR TO SEND /	35		
		34	RIM /CLEAR TO SEND /
LOCAL MODULES /RECEIVE DATA /	33		
		32	RIM /RECEIVE DATA /
LOCAL MODULES /TRANSMIT DATA /	31		
	=key=		
		30	RIM /TRANSMIT DATA /
CFG GROUND	29		
(JUMP PIN 27 TO 29 FOR DEBUG MODE)		28	
CFG RUN/TRAP; 0FFFFH CONFIGURATION BIT 3 = (8)	27		
		26	
CONFIGURATION BIT 2 = (4)	25		
		24	
CONFIGURATION BIT 1 = (2)	23		
		22	
CONFIGURATION BIT 0 = (1)	21		
		20	
CONFIGURATION BIT 5 = (32)	19		
		18	
CONFIGURATION BIT 4 = (16)	17		
		16	
RS-485 B	15		
		14	
RS-485 A	13		
	=key=		
		12	
RS-485 SHIELD	11		
		10	
HOST 232 CTS	9		
		8	
HOST 232 RTS	7		
		6	
HOST 232 GND	5		
		4	
HOST 232 TXD	3		
		2	
HOST 232 RXD	1		

Notes

Chapter 2: BEFORE YOU BEGIN

SAFETY PRECAUTIONS

Review the following statements before installing, servicing, or replacing the PLC033 Programmable Logic Control or any of its components.

GENERAL PRECAUTIONS

Only trained and qualified personnel should install, service, or replace this equipment.

Carefully read the installation and wiring instructions before connecting the PLC033 to its power source.

Do not work on the PLC033, or connect or disconnect any of its cables, during periods of lightning activity.

To prevent overheating the PLC033, do not operate it in an area that exceeds the maximum recommended temperature range of $0^{O}C$ ($32^{O}F$) to $70^{O}C$ ($158^{O}F$).

Ensure that the unit is connected to earth ground during normal use.

Precautionary measures must be observed when installing, operating, and servicing the PLC033 in order to prevent shock from voltages present.

If the PLC033 is to be installed into an existing control panel, make sure that all breakers are shut off before starting the installation.

All wiring should conform to federal, state, and local electrical codes.

When using the PLC033, observe the following safety guidelines:

- To help prevent electric shock, wire the PLC033 and peripheral power cables into properly grounded power sources.
- Be sure nothing rests on the PLC033's cables and that the cables are not located where they can be stepped on or tripped over.

WORKING WITH THE PLC033

Before working with the PLC033 where the removal of components is necessary, perform the following steps in the sequence indicated:

1. Power down the unit.
2. Turn off all circuit breakers to the PLC033.
3. Ensure that any cables connected to the PLC033 will not become entangled in or caught on anything in the surrounding area.

When disconnecting a cable, pull on its connector or on its strain-relief loop, not on the cable itself. Some cables have a connector with locking tabs; when disconnecting this type of cable, press in on the locking tabs before disconnecting the cable. When pulling connectors apart, you should keep them evenly aligned to avoid bending any connector pins. Also, before connecting a cable, make sure both connectors are correctly oriented and aligned.

PROTECTING AGAINST ELECTROSTATIC DISCHARGE

Static electricity can harm delicate components inside the PLC033. To prevent static damage, put on an electrostatic discharge wrist strap before touching any of the PLC033's electronic components.

In addition to the preceding precautions, the following steps can be taken to prevent damage from electrostatic discharge (ESD):

- When unpacking a static-sensitive component from its shipping carton, do not remove the component's antistatic packing material until ready to install the component in the PLC033. Be sure to put on an electrostatic discharge wrist strap before unwrapping the antistatic packaging.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all sensitive components in a static-safe area. Place the equipment on a grounded surface. If possible, use antistatic floor pads and workbench pads.

Note: Contact DFS if electrostatic discharge packaging is needed for return shipments. See Return Authorization (RA) Procedure, p. 53 for more information on returning equipment.

RECEIPT OF EQUIPMENT

When equipment is received, examine the outside of the carton for any damage incurred during shipment. Remove the packing list and the equipment from the shipping carton. Carefully inspect the equipment for damage. Resolve any damage with the local carrier. Report damages to Data Flow Systems (321-259-5009). Include the serial number of the unit and the extent of damage in your report.

Chapter 3: PRINCIPLES OF OPERATION

The PLC033 is a powerful programmable logic controller that can be installed in a DFS Remote Terminal Unit (RTU). This microprocessor-controlled unit is designed for implementing local logical control at the RTU via an installed ladder logic program. Users configure the PLC033's I/O and communication settings and create the ladder logic program using the applications included in the supplied Process Management Toolkit (PMT) software.

INSTALLED IN SPECIALLY-DESIGNED RTU

The PLC033 must be installed in a specially-designed RTU – one with a modular backplane (MBP) that has been modified to split the communications bus into two entities: the Radio Bus and the Module Bus. The MBP is a printed circuit board composed of card edge connectors for the modules, module bus circuitry, and a connection for the back-up battery. The PLC033, and all other DFS plug-in function modules used in the system, are plugged into card edge connectors mounted on the RTU's MBP.

LOGICAL I/O

The PLC033 itself doesn't have any physical I/O; it is strictly a programmable device that polls external I/O and responds to polls from a central site, and then performs logic on this data using an installed ladder logic program.

The PLC033 polls the I/O on the Module Bus (i.e., up to 15 local DFS function modules) as well as the I/O of any Modbus-compatible devices connected to the PLC033's COM1 port. The COM1 port can be used in either RS-232 or RS-485 mode, which enables it to support a single RS-232 device, or multiple RS-485 devices. The PLC033 can communicate with these devices using either Modbus ASCII or Modbus RTU protocol.

TYPICAL INSTALLATION

In a typical installation, the PLC033 is installed between the RIM (Radio Interface Module) and up to 15 DFS function modules. The PLC033 uses the Radio Bus to communicate with the RIM and the Module Bus to communicate with the DFS function modules. Once installed in the RTU, the PLC033 automatically communicates with the other DFS function modules over the Module Bus, getting their status and updating their outputs according to the ladder logic program. It communicates with the central site via the RIM interface, relaying status and control information. It can also simulate "logical" analog and digital modules to allow the PLC033's program to interact with the SCADA system.

EMULATE MULTIPLE DFS RTUS

The PLC033 can emulate up to two RTUs. This allows developers to exceed the 15 module maximum for DFS RTUs. This is accomplished in PMT's Mapper by right-clicking the main branch of the Radio Map and selecting "Add Remote Device." This remote device can accommodate up to 15 DFS modules.

The Remote Device Number should be the next station number after the physical address of the station the PLC is installed in (for example, if the PLC is in RTU #17 then add remote device #18 in the Radio Map.

When configuring the remote device (emulated station) In HyperTAC II, the remote device's RIM type should be configured as a RIM004. The station number in HyperTAC II must match that configured for the remote device in PMT.

For more information, refer to the section titled "Adding a Remote Device (Emulated DFS RTU)" in the Process Management Toolkit User Manual.

PLC CENTRAL

Another important feature of the PLC033 is its ability to function as a PLC central. The PLC Central feature enables the PLC033 to poll remote DFS RTUs in addition to local modules and local Modbus-compatible I/O. PLC Central can be a secondary function of the PLC033 or its primary function. The PLC033's mode is determined by the value of Special Function Register "Comm 2 DFS Central Mode." When the register is true, the PLC033 functions as a PLC central.

As a secondary function (limp, or backup, mode), the PLC033 can temporarily switch to PLC Central mode when it determines that communications with the HyperTAC II central have been lost. This mode uses two timers that are inserted in the PLC033's ladder logic program that instruct the PLC033 when it should switch to PLC Central Mode (Comm 2 DFS Central Mode is set to "true") and when it should return to normal operation (Comm 2 DFS Central Mode is set to "false") to check if communications with the HyperTAC II central have been restored.

For RTU systems that require a centralized site for logic, but aren't large enough to warrant a HyperTAC II central site, the PLC033 can be forced to permanently stay in PLC Central mode by setting and keeping the Comm 2 DFS Central Mode register at a "true" value in the PLC033's ladder logic program.

This function is discussed in more detail in Appendix B: Application Notes in the section titled "Implement PLC Central Function" beginning on page 43.

SET POINT VARIABLES (Q POINTS)

Q points, named as such because they always reside at module address Q in HyperTAC II's Configuration Editor, are used to create user set point variables beyond the PLC's 15-module limit. Q points allow you to access and use the PLC's 168 free (unused) memory locations.

Q points are non-scaled, 32-bit floating point values that are readable and writable over telemetry via DFS radio or network (NIM) protocol. The Q point registers reside in the 49000 range beginning at register 49464 and ending at register 49798. Because Q points are 32-bit floating point values, each point

requires two registers; each Q point begins on an even register (e.g., Q point number 50 resides at registers 49562 and 49563).

Q points do not have to be configured in I/O Builder. The 168 Q points are automatically added to the Logical Memory Map when a PLC project is created. Each point is given a label that begins with the letter Q (e.g., Q1, Q2, Q3, etc.). Additionally, they do not have to be mapped from the Logical Memory Map into the DFS Radio Map. Q points are mapped internally and respond to specially-formatted messages sent from HyperTAC II. Like other I/O, Q points can be used in ladders and in custom screens.

It is important to note that Q points are not designed to be used as status points. In HyperTAC II, they are not polled as often as "normal" I/O; doing so would negatively impact the polling loop. However, as a set point variable, the control is acted on immediately.

To add Q points to an existing PLC project, you must chang the project type to RDP and then change it back to PLC. If you have I/O in the Logical Memory Map that is mapped to the registers assigned to Q points, they will not be overwritten. The Q points will be placed "around" the taken registers and will always start at an even register number.

Like the reserved set point registers set aside for storing user set point values (discussed on page 6), Q Point values are automatically saved to the PLC033's flash memory every 30 seconds and also during a controlled shutdown. These stored values are loaded when the process resumes.

NETWORK SLAVE DEVICE

In addition to being a programming interface, the PLC033's Ethernet port enables it to function as a network slave device using either DFS NIM RTU protocol or Modbus TCP protocol.

As a DFS NIM RTU slave, the PLC033 can be polled by a HyperTAC II central over the network. This feature can be used simultaneously with radio polling, so that one RTU can be polled from two different systems: one on the network and one over the radio link. Alternatively, the PLC033 can function solely as a network device by placing an RS-232 RIM (RIM board without the radio installed) in the RTU and polling the PLC033 from the HyperTAC II central using the DFS NIM protocol. There is no additional configuration required to implement either of these functions. The PLC033 will automatically respond to network queries as well as radio requests if the DFS Radio Map is configured (explained in more detail in "I/O Mapping" on page 16). Note that the DFS NIM RTU interface uses the radio map; there is not a separate map for using network communications.

As a Modbus TCP slave, the PLC033 can be polled by any Modbus-compatible software that uses the Modbus TCP protocol.

The PLC033 requires its own unique network IP address in order for it to be polled over the network. Refer to the section titled PLC Network Settings" in Chapter 5: Hardware Installation beginning on page 27, as well as the ***Process Management Toolkit User Manual***, for more information on PLC033 IP addressing.

MODBUS SERIAL MASTER / SLAVE DEVICE

The PLC033 can function as a Modbus RTU/ASCII serial master or slave device via its COM1 serial port. As a Modbus serial master, the PLC033 can poll a single Modbus-compatible RS-232 device, or multiple Modbus-compatible RS-485 devices via its COM1 serial port using either the Modbus RTU or ASCII protocol. As a Modbus serial slave, the PLC033 can be polled by any Modbus-compatible software that uses the Modbus RTU or ASCII protocols.

When configuring this port (i.e., Modbus driver) in PMT's Configuration Editor, you must select either SERIAL_MASTER or SERIAL_SLAVE for the TYPE option. Configuration Editor will only allow the addition of devices and I/O under a Modbus driver when TYPE is set to SERIAL_MASTER. When this port has been configured as a serial slave, it *cannot* be used as a serial master. The functionality of this port is not switchable as is the PLC Central feature. The port's function can only be modified by changing the TYPE setting.

SUPPORTS MULTIPLE PROTOCOLS

At its core, the PLC033 is a Modbus device. Modbus is an industry-standard protocol and as such enables the PLC033 to communicate with any third-party Modbus devices, including Open Control Solutions' RIO128 and RIO032 rail-mounted I/O devices. The PLC033 is able to support both DFS and Modbus protocols through a process called mapping. In mapping, each physical I/O point is assigned to a unique register in the PLC033's Logical Memory Map. The Logical Memory Map is comprised of four register ranges:

I/O Type	Register Range
Digital Outputs (Coils)	00001-09999
Digital Inputs (Discrete Inputs)	10001-19999
Analog Inputs (Input Registers)	30001-39999
Analog Outputs (Holding Registers)	40001-49999

I / O MAPPING

The physical I/O of local DFS function modules as well as the I/O of any external Modbus-compatible devices must be mapped. This ensures that there are no duplicate, or conflicting, addresses. Once mapping is complete, these registers are available for use in ladders and custom screens. When doing this type of mapping, you need to be aware of the registers that have been set aside for special functions (for example, controlling the four programmable LEDs) and the registers reserved for set points. A list of these registers can be found in Chapter 1: Product Overview.

A second form of mapping, DFS Radio mapping, is required in order for the PLC033 to be polled by a HyperTAC II system. In this process, the registers in the Logical Memory Map are mapped to up to 30 DFS modules [up to 15 modules per station with a two (2) station maximum]. For example, registers in the 00001-09999 range (digital outputs) would be mapped to one or several Digital Control Modules (DCM003); registers in the 40001-49999 range (analog outputs) would be mapped to one or several

Analog Control Modules (ACM002). The mapped I/O can be any combination of physical I/O, logical I/O generated by ladder programs, and special function registers.

Because the DFS radio link uses a 12-bit protocol with a full-scale output of 4095, you must specify how you want to shift the bits in the register when working with any data that is greater than 12 bit that will be sent over the DFS radio link (for example, 15-bit RIO128 data or 16-bit logical data). Details on this process can be found in the section titled "DFS Radio Mapping: Register (Bit) Shifting Options" in the ***Process Management Toolkit User Manual***.

PROGRAMMING INTERFACE

The PLC033's Ethernet port is its interface to the Process Management Toolkit (PMT), a suite of applications used to configure, program, and test the PLC033.

When interfacing with the PMT, the PLC033 can be accessed using a "closed" network. This is accomplished by directly connecting the PLC033 to a laptop or desktop computer using an Ethernet crossover cable. With a closed network, the PLC033's network settings can be left at the default IP address of 192.168.1.10.

Note that if the PLC033 is going to be configured, programmed, or polled over the network, it requires its own unique network IP address.

More information on PLC IP addressing can be found in Chapter 5: Hardware Installation in the section titled PLC Network Settings" beginning on page 27, as well as in the ***Process Management Toolkit User Manual***.

PROGRAMMED WITH LADDER LOGIC

The PLC033 is programmed using Logic Builder, a user-friendly application that enables you to construct "ladder logic"-style programs that manage complex control functions. Ladder logic is a graphical (symbols and text) language that is used to plan, maintain and control industrial systems. Each rung of the ladder (hence the name - ladder logic) is used to control a single output.

The results of these graphical programs are logical points and auto controls that are continuously scanned by the system. The speed of the scanning process enables you to have the most up-to-date information, which, in turn, allows you to react to situations quickly and efficiently.

In traditional ladder logic, the values that flow along rungs and branches are strictly logical, 0 or 1. DFS' Logic Builder provides the extra flexibility of allowing rungs and branches to hold numeric values (for example, the results of math operations, such as ADD and MAXIMUM, and inputs from analog points).

After a ladder logic program has been built and installed, its logical points and auto controls can be used in custom screens (graphical representations of your process control system) that can be used to remotely monitor and control your system.

MONITOR AND CONTROL VIA CUSTOM SCREENS

Graphical representations of your process control system can be created using the Screen Builder application. Building a screen – using text, images, objects, and animation – and linking the screen's components to real or logical I/O, enable you to get a real-time view of your operation as well as control processes from a remote location.

For example, you can build a screen that shows the flow of a pump or the level in a well, and then use the device's address (register) to link it to the real field hardware. This linking lets you create a virtual picture of how the equipment is operating; the screen mimics the activity of the equipment. It also enables you to control devices from a remote location. For example, a screen with an On/Off button that is linked to a pump motor can be used to start or stop a pump.

CONTROLLED SHUTDOWN

The following events initiate a controlled shutdown:

- If voltage in the panel falls to 11.2 volts, the PLC's operating system will initiate the shutdown without user intervention.
- Press the shutdown button on the PLC to manually stop the process.
- Use Special Function Registers – Remote Process Start Command (9920) and Remote Process Stop Command (9921) – to shutdown the process from a remote location. For example, you could map these registers to a DFS module point in the PLC's DFS Radio Map and configure the same point in HT3. The registers could then be controlled from a custom screen or a default screen.

TYPICAL DFS-RTU PLC033 APPLICATION

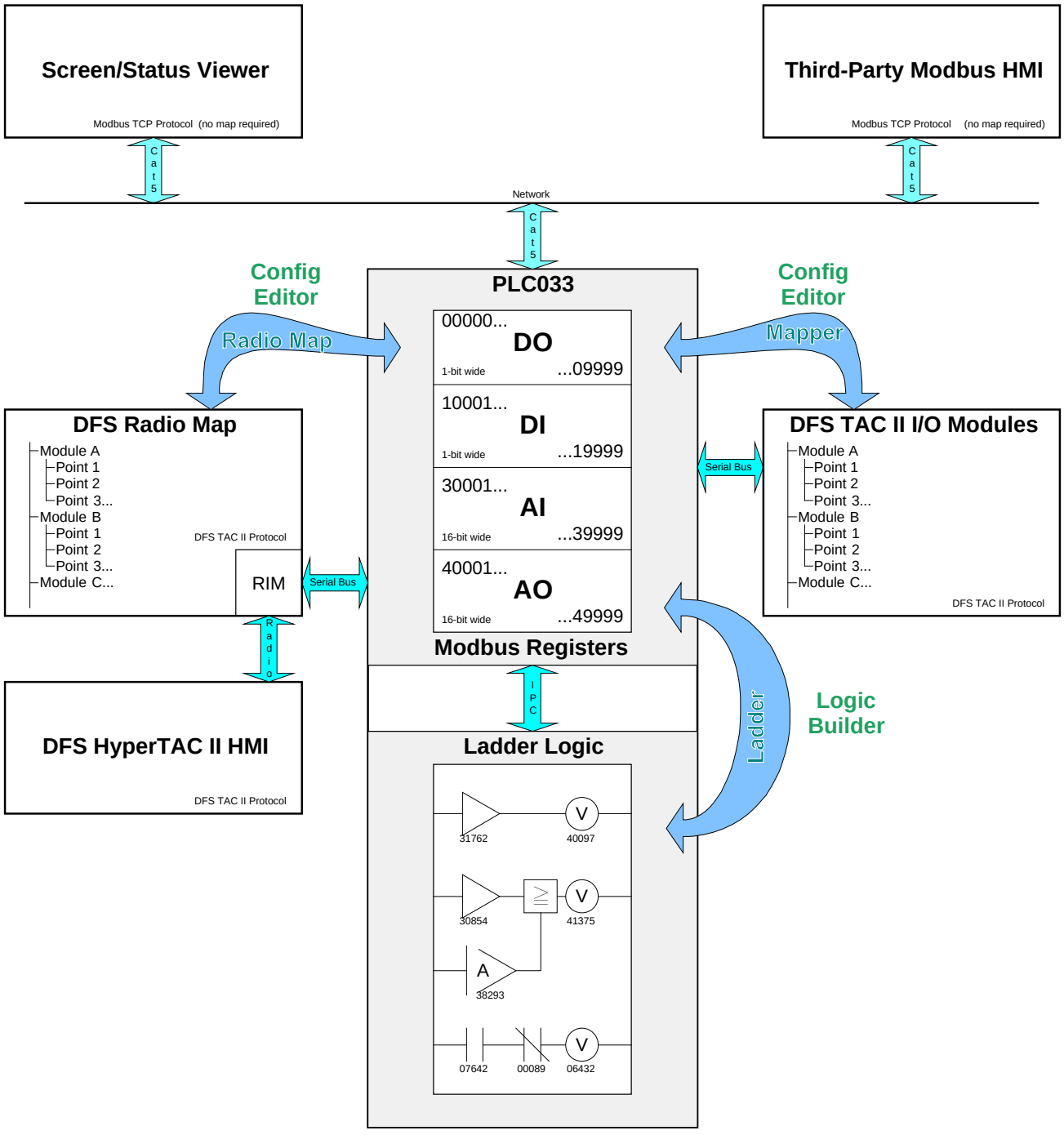


Figure 3-1, Typical PLC033 Application

Notes

1. Define the problem. What problem are you trying to solve by installing the PLC? What kind of I/O do you need? What do you need to monitor and control in the field? What information needs to be sent back to the central computer?
2. Install the PLC and all related hardware. Discussed in Chapter 5: Hardware Installation
3. Create a new project in the Project Management Toolkit and define the basic settings, including IP address and mode (PLC or RDP). Discussed in the ***Process Management Toolkit User Manual***.
4. Define ranges for the physical I/O, user-defined logical I/O (for example, virtual analog inputs and outputs you create in Logic Builder), and the logical I/O generated internally by Logic Builder. Be aware that the high end of the digital output and analog output ranges are reserved for user set points and special functions (see Chapter 1: Product Overview for more information).

   We recommend the following:

Range Type	Digital Outputs	Digital Inputs	Analog Inputs	Analog Outputs
Physical I/O	1-1000	10001-11000	30001-31000	40001-41000
User-defined Logical I/O	1001-1999	11001-11999	31001-31999	41001-41999
System-generated logical I/O	2000-9799	12000+	32000+	42000-49799
Reserved set point registers	9800-9899	---	---	49800-49899
Special Function Registers	9900+	---	---	49900+

5. Add and configure the physical I/O using I/O Builder. Discussed in the ***Process Management Toolkit User Manual***.
6. Map the physical I/O into the appropriate register ranges using the Register Map. Discussed in the ***Process Management Toolkit User Manual***.
7. Transfer the mapped I/O to the PLC. Discussed in the ***Process Management Toolkit User Manual***.
8. Create a ladder logic program that can locally control the hardware (monitor status, make decisions, perform calculations, etc.). Install the ladder in temporary memory during testing. When everything is working correctly, flash it to permanent memory. Discussed in the ***Process Management Toolkit User Manual***.
9. Map logical I/O into the DFS Radio Map and transfer it to the PLC. Note that it isn't necessary to map all of the logical I/O; only the I/O that will be sent over the radio link. Discussed in the ***Process Management Toolkit User Manual***.
10. Create custom screens that enable users to view the status of equipment or control set points. Discussed in the ***Process Management Toolkit User Manual***.

Notes

INSTALLING THE PLC033 IN THE RTU

The PLC033 must be installed in a specially-designed DFS RTU. In a PLC-capable RTU, the modular backplane (MBP) has been modified to separate the signals that go between the PLC033 and the Radio Interface Module (RIM) (referred to as the Radio Bus), and the PLC033 and the local function modules, including modules in a separate enclosure connected with BEM001s (referred to as the Module Bus).

The hardware installation of a PLC module into an RTU is slightly different than that of a regular I/O function module. Any LOCAL modules (including modules in a separate enclosure connected with BEM001s) that need to be monitored or controlled by the PLC must be connected to the communications bus of the PLC, but separated from the communications bus of the Radio Interface Module (RIM). The PLC033 (and all other modules installed in the RTU's modular backplane) get their power from the RTU's power supply module via the bus.

The PLC033 is wired into an RTU, typically between the Radio Interface Module (RIM) and up to 15 other local modules. Normally, the PLC033 is located in the slot just to the left of the RIM, and only one PLC033 may reside in each RTU. Consult DFS Engineering personnel for proper integration information if variations to this standard installation are required.

IMPORTANT: The RIM used in a PLC033 RTU must be a RIM006 model and have a ROM version of 12/08/05 or later *unless* the PLC033 will be communicating solely over the network in which case an RS-232 RIM (RIM without a radio installed) is placed in the RIM slot.

For a PLC033 using the DFS radio link, if the RIM doesn't meet the specifications outlined above, no communications will take place between the PLC033 and the radio.

The RIM will appear to be locked in transmit mode when observing its transmit LED (the LED will be constantly on). Additionally, abort messages will appear when radio traffic is monitored using HyperTAC II's Telemetry Traffic Tool.

Instructions for determining ROM level appear on the next page. If you find that you're RIM is not at version 12/08/05 or later, contact DFS' Service Department for information on upgrading.

CHECKING RADIO'S ROM VERSION

As discussed above, the RIM used in a PLC033 RTU must be a RIM006 and must have a ROM version of 12/08/05 or later. There are several ways to check the ROM's version.

CHECK THE ROM LABEL

You can find the ROM version listed on a label attached to the radio's ROM chip. Simply remove the RIM's cover plate to verify the version number. Refer to the illustration below for the location of the label.

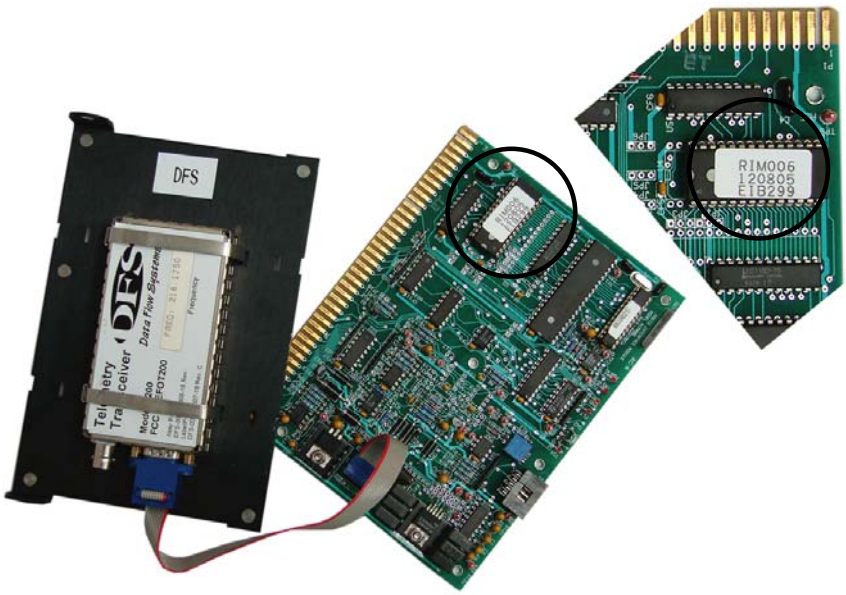
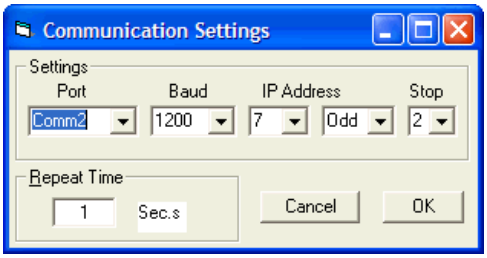


Figure 5-1, ROM Label on Radio Interface Module (RIM)

USE WINRTU TEST

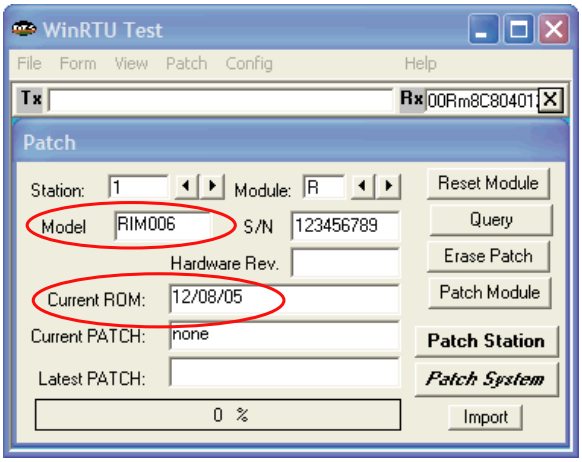
A RIM in the field or one that is set up on a test bench can be queried using WinRTU Test.

1. Connect a laptop or desktop computer that has WinRTU Test installed to the RIM's service port using the cable provided with WinRTU Test.
2. Launch WinRTU Test.
3. Set WinRTU's communication settings by selecting **Comm** from the **Config** menu.



For Port, select the serial port on the computer to which the RIM is connected. Select 1200 for baud rate. Verify that data bits is set to 7, parity is set to Odd, and stop bits is set to 2. Click OK.

4. Select **ROM Patch** from the **Form** menu. Click **Query**.



Messages will appear in the Tx and Rx fields as WinRTU Test begins communicating with the RIM. After a few seconds, the Model number, serial number, and Current ROM will appear in the form. Verify that the model is a RIM006 and the Current ROM is 12/08/05 or later.

USE HYPERTAC II'S TELEMETRY TRAFFIC TOOL

If the RTU is online and can be accessed via telemetry, you can launch HyperTAC II's Telemetry Traffic tool and query the station for its version.

1. Enter the RTU's station number in the Station box and enter R in the module box.
2. Click Start to begin communicating with the station.
3. When you see that messages are being received from the station (green messages), click the Version button. You should see a blue message requesting version ("Message: Requesting

version for X R", where X represents the station number). Shortly thereafter you should see a response ("Reply {0XRr RIM006 12/08/05}", where X represents the station number.

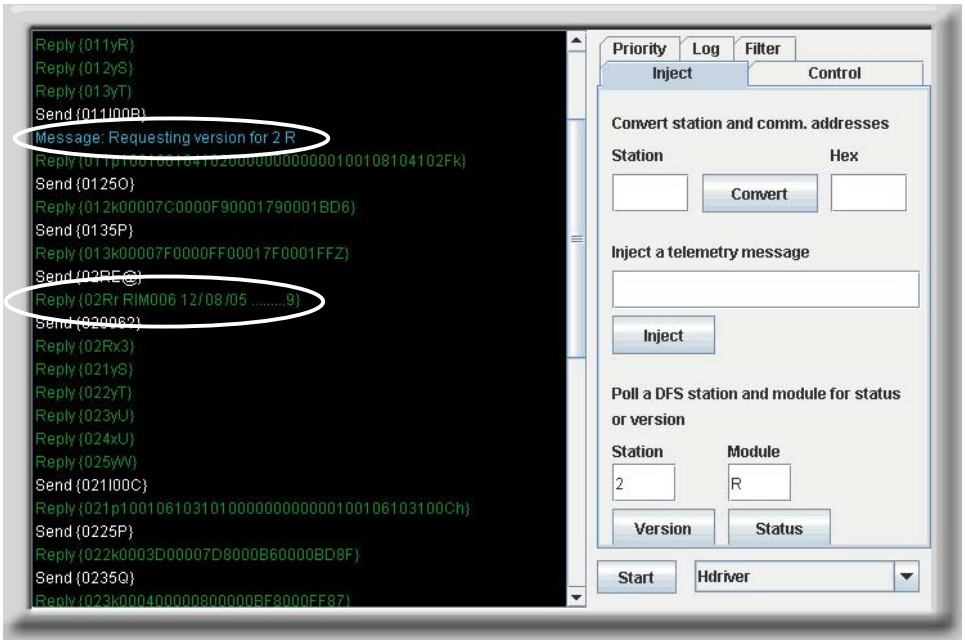


Figure 5-2, Check Radio ROM Version from HyperTAC II

PLC BY-PASS CARD

The PLC By-Pass Card may be used in order to test basic module polling and control/status wiring of the modules in an RTU configured for use with a PLC. The PLC By-Pass Card is a static hardware device that allows the communications bus of the RIM to be reconnected to the module communication bus. Once the By-Pass Card is installed into the PLC card edge connector, the RTU will function identical to that of a standard RTU (i.e., an RTU with the I/O modules connected directly to the RIM).

Refer to the WinRTU Test Manual for testing basic control and status signals wired into DFS function modules.

NETWORK INTERFACE

The PLC033 features a 10/100base-T network interface. This Ethernet port is used when configuring and programming the PLC. In addition to being the PLC033's programming interface, the Ethernet port enables the PLC033 to function as a network slave device using either DFS NIM RTU protocol or Modbus TCP protocol. A standard network crossover cable with RJ-45 connectors is all that is needed in most cases to connect the PLC to a computer. However, if the PLC is going to stay on the network permanently, we recommend that you install a 100Base-T Network Surge Arrestor, which can be ordered from Data Flow Systems (DFS Part No. 002-0279).

PLC NETWORK SETTINGS

The PLC must be on a network – either a local area network (LAN) or a closed network – to be configured and programmed.

When a PLC leaves the factory, it is set to a default IP address of 192.168.1.10. PLCs that will be using a radio link to communicate can be left at this default setting. However, if a PLC is going to be a network device, your network administrator must assign it a unique network IP address. The PLC is configured with this assigned *"destination"* IP address via the Settings dialog box in the Process Management Toolkit (select **File** from the **Settings** menu). If the PLC isn't going to be a network device, leave the destination IP at the factory default setting.

A second IP setting – the Target IP (select **File** from the Process Management Toolkit's **Target** menu) – is only used when installing and retrieving configurations. The Target IP is the PLC's *current* IP. For a PLC that has just arrived from the factory, the Target IP is 192.168.1.10 (the factory default). For a PLC that has been configured, the Target IP will be the IP specified in the **Settings** dialog. Note that if the PLC hasn't been used as a network device, then the destination IP (the address specified in the **Settings** dialog) is the factory default 192.168.1.10 *unless* this was changed by someone configuring the PLC.

Normally, the IP addresses specified in **Target** and **Settings** will be identical. However, when you are first setting up a network-bound PLC, the IP addresses will be different. In the **Settings** dialog, you will enter the IP that you network administrator assigned to the PLC (its *"destination"* IP). In the **Target** dialog, you will enter the PLC's current IP – the factory default 192.168.1.10. This allows you to tell the PLC what its IP address *will* be while communicating with the PLC using its current (Target) IP address.

Another scenario where the Target and Settings IP could be different is if you needed to move the PLC to another IP address on your network. You would set the Target IP equal to the PLC's current address and then provide the PLC with its new destination IP address via the **Settings** dialog.

MODBUS SERIAL MASTER / SLAVE INTERFACE

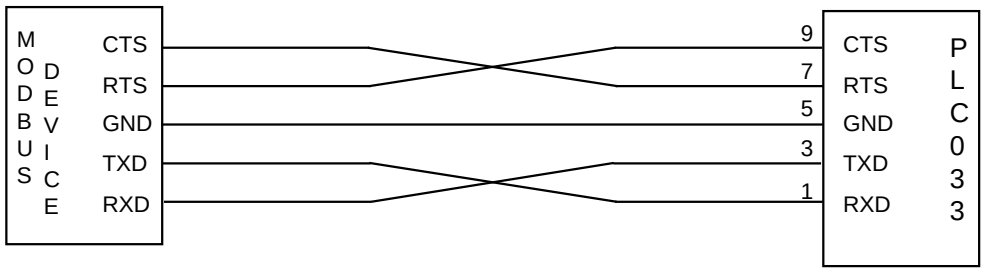
The PLC033 features three serial ports. One of these, COM1, can be used in either RS-232 *or* RS 485 mode to communicate with external serial master or slave devices. The PLC033 can communicate with these devices using either Modbus ASCII or Modbus RTU protocol. When used as a Modbus serial master, the PLC033 can support a single RS-232 slave device or multiple RS-485 slave devices.

For RS-232 mode, use pins 1, 3, 5, 7, and 9; For RS-485 mode use Pins 11, 13, and 15.

Review the drawings below and on the next page before connecting a device to the COM1 part.

IMPORTANT: Do not use the PLC's RS-232 service port when connecting to a serial master or slave device. The service port is for use by DFS personnel only.

RS-232

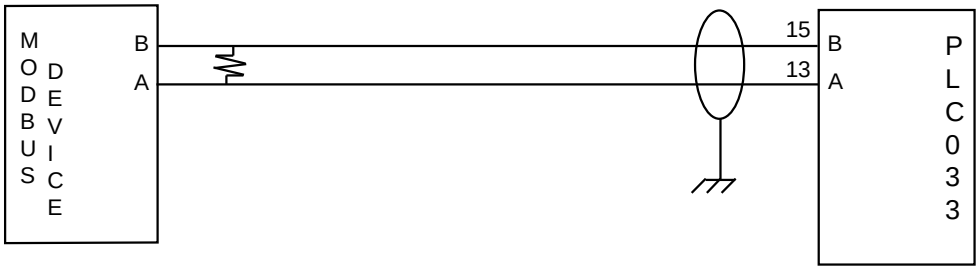


NOTES:

1. RTS (request to send) and CTS (clear to send) connections are required to enable hardware flow control.
2. If a 3-wire interface is required, jumper RTS to CTS on both ends of the cable.

Figure 5-3, Wiring RS-232 Interface

RS-485



NOTES:

1. The cable shield wire must only be grounded at one end (as close as possible to the selected end).
2. Requires 150-200 ohm resistor (resistors should only be placed at the extreme ends of the RS-485 network).

Figure 5-4, Wiring RS-485 Interface

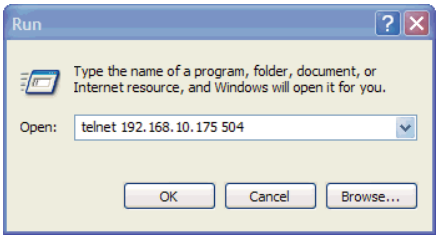
NO COMMUNICATION TO FUNCTION MODULES

If you are having problems communicating from the PLC033 down the bus to the function modules, you can perform a "data tap" to determine if the problem is hardware related. A data tap is performed using a standard Telnet connection. It enables you to view outgoing and incoming messages from the PLC master to the modules. If messages are going out from the PLC033 to the function modules, but no messages are coming in, the problem may lie with the module bus or with the module itself.

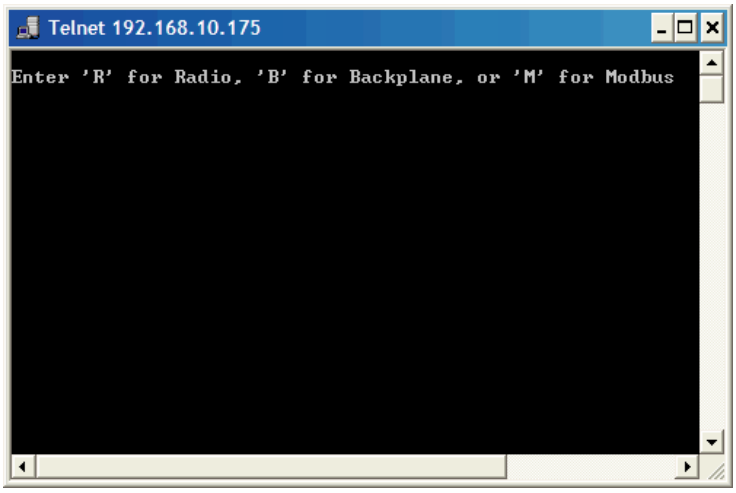
1. Open a Telnet connection by selecting Run from the Windows Start menu and typing

   telnet xxx.xxx.xxx.xxx **504**

   Where **xxx.xxx.xxx.xxx** is the PLC's IP address followed by **504** (the network port for this Telnet application). If you are using a closed network to connect to the PLC033 (crossover cable between the PLC033 and the computer), change the network settings for your computer so that it is on the same network as the PLC. For example, if the PLC was at the factory default IP (192.168.1.10), you could set your computer to 192.168.1.101 and telnet to 192.168.1.10.

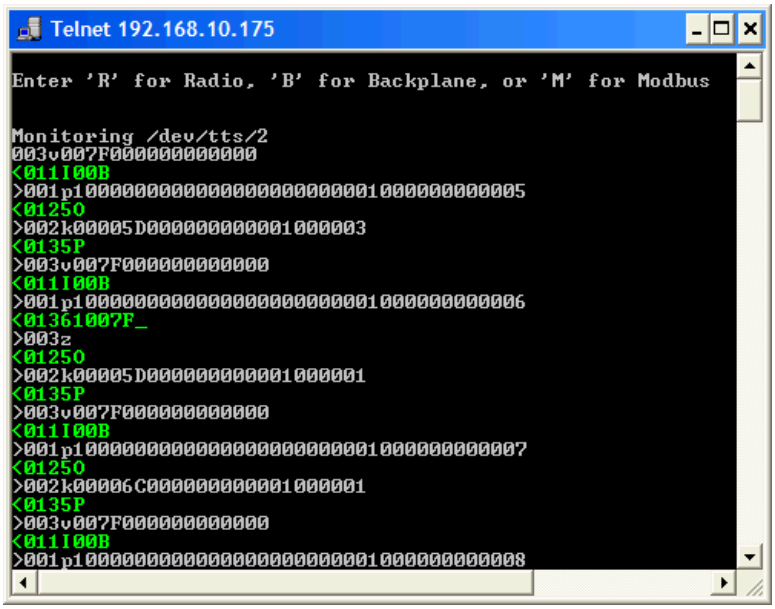


2. Click OK to open a Telnet connection. A Telnet window opens with instructions for testing the radio backplane, the module backplane, or the Modbus (COM1) port.



(continued on next page)

3. Type B and press the Enter key. You should begin seeing transmitted messages and responses. Transmitted messages (messages sent from the PLC to the module bus) are green in color and are preceded by a left-pointing carat (<). Responses (messages sent from the module bus to the PLC) are white in color and are preceded by a right-pointing carat (>).



A problem communicating with the module backplane hardware is indicated when intermittent or no responses are received from the module bus.

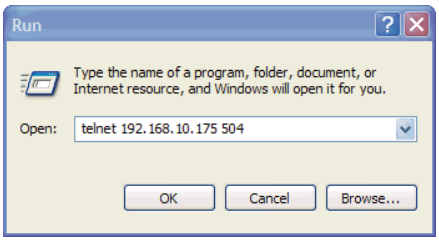
NO COMMUNICATION TO RS-232/485 MODBUS DEVICES

If you are having problems communicating from the PLC033 to RS-232 or -485 Modbus-compatible devices, you can perform a "data tap" to determine if the problem is hardware related. A data tap is performed using a standard Telnet connection. It enables you to view outgoing and incoming messages from the PLC master to the Modbus-compatible devices. If messages are going out from the PLC033 to the devices but no messages are coming in, the problem may lie with the configurations (Were they uploaded to the PLC? Are they correct?), the connection to the device (Is it connected properly? Is the cable damaged?), or with the device itself.

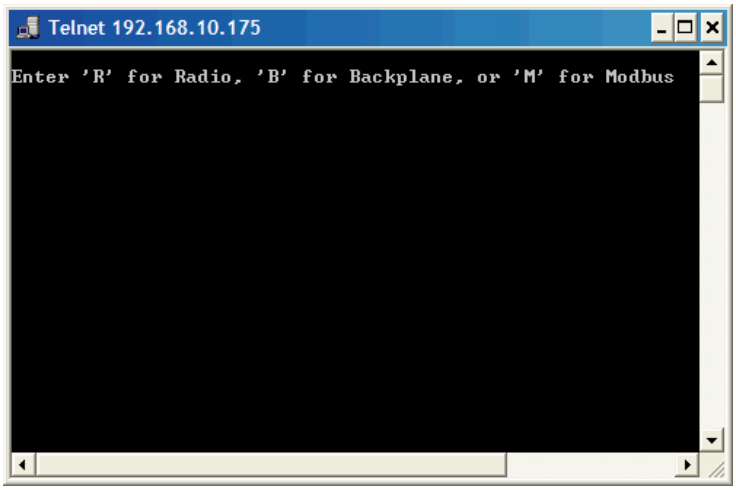
1. Open a Telnet connection by selecting **Run** from the Windows **Start** menu and typing

   telnet xxx.xxx.xxx.xxx **504**

   Where **xxx.xxx.xxx.xxx** is the PLC's IP address followed by **504** (the network port for this Telnet application). If you are using a closed network to connect to the PLC033 (crossover cable between the PLC033 and the computer), change the network settings for your computer so that it is on the same network as the PLC. For example, if the PLC was at the factory default IP (192.168.1.10), you could set your computer to 192.168.1.101 and telnet to 192.168.1.10.

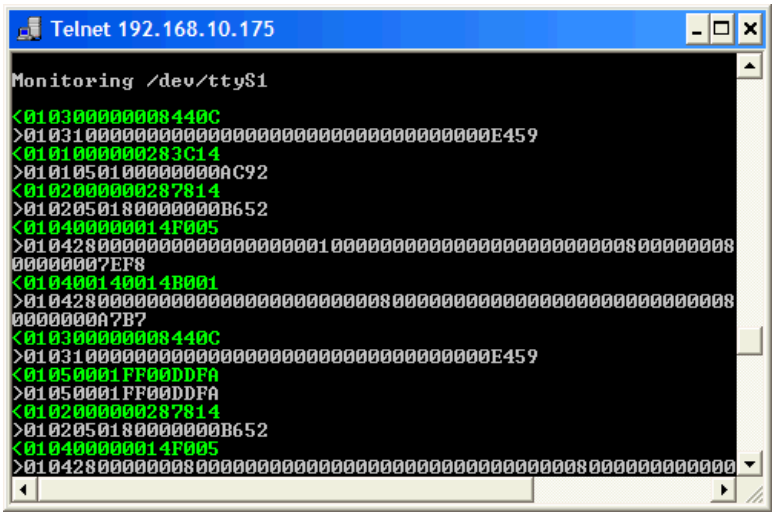


2. Click OK to open a Telnet connection. A Telnet window opens with instructions for testing the radio backplane, the module backplane, or the Modbus (COM1) port.



(continued on next page)

3. Type M and press the Enter key. You should begin seeing transmitted messages and responses. Transmitted messages (messages sent from the PLC to the COM1 Modbus port) are green in color and are preceded by a left-pointing carat (<). Responses (messages sent from the COM1 port to the PLC) are white in color and are preceded by a right-pointing carat (>).



A problem communicating with the COM1 port hardware is indicated when intermittent or no responses are received from the module bus.

NO POWER TO FUNCTION MODULES

If you notice that the PSM, RIM, and PLC are powered, but the function modules downstream of the PLC are not powered, the problem is probably due to the module bus fuse on the PLC033.

The PLC033 is equipped with two fuses that control power along the bus. One fuse is for incoming power from the PSM side of the bus. The second fuse is for power to the module side of the bus.

This is a factory repair. See Appendix F: Support, Service, and Warranty for information on the procedure for returning the PLC033 to DFS for repair.

If you have a spare PLC033 on site, you can replace the faulty PLC033. Before replacing the PLC033, download its configurations into the PMT software, so they can be uploaded to the spare. See "Retrieve Information from an Existing PLC033" in the ***Process Management Toolkit User Manual*** for more information.

Before installing the spare PLC033, it is important to identify and correct the condition that caused the fuse to blow in the first PLC. Possible causes of a blown fuse include a bad module or backplane. A device connected to the 12VDC backplane bus could also be the source of a blown fuse. Keep in mind when connecting devices to the backplane bus that it is fused at 10amp. The fuse itself, including its age, an internal defect, or heat build up due to bad connections should also be considered.

If you need assistance with this process, contact DFS' Service Department.

RIM Locked in Transmit Mode

The RIM used in a PLC033 RTU must be a RIM006 model and have ROM code version 12/08/05 or newer installed. If the RIM doesn't meet these specifications, no communications will take place between the PLC033 and the radio.

The RIM will appear to be locked in transmit mode when observing its transmit LED (the LED will be constantly on). Additionally, abort messages will appear when radio traffic is monitored using HyperTAC II's Radio Traffic Tool.

To verify that the RIM has the latest ROM code installed, use HyperTAC II's Radio Traffic Tool to query the RIM for its version. The version must be 12/08/05 or later. If you have an older version of ROM code, contact DFS' Service Department to arrange an upgrade.

Connection Refused

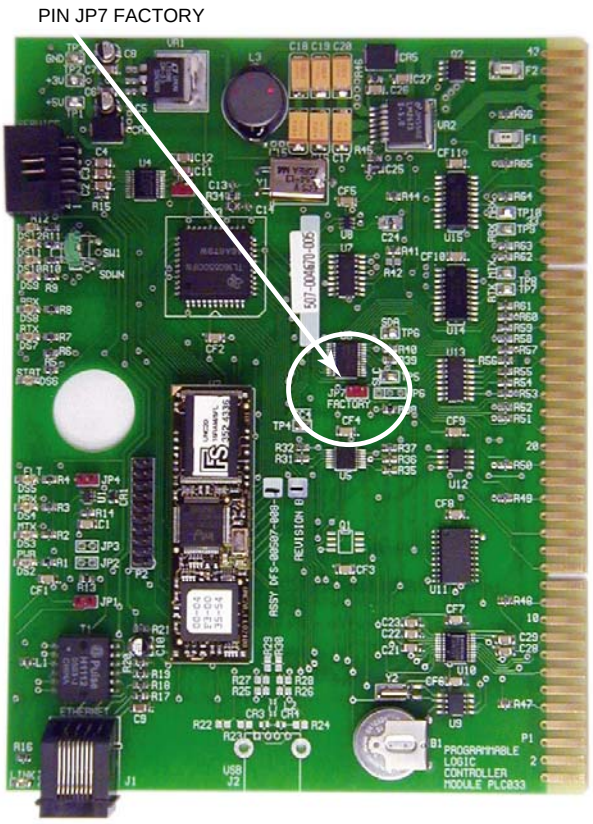
If you receive a "connection refused" error when trying to connect to a PLC033 from the Process Management Toolkit (PMT), first verify that the correct IP was entered in the **Target** (File -> Target) and **Settings** (File -> Settings) dialog boxes and that you can ping the IP.

If the IP address is correct and the ping was successful, the issue may be caused by personal firewall software installed on your computer. If a firewall is present, you must either add the PMT software to the firewall's list of approved programs or add the IP address of the PLC033 to the list of trusted networks. Without these settings, the firewall may not allow Java – the language on which PMT is built – to connect to the PLC033's IP address.

BROADCAST PLC033 IP

If you need to find out the IP address to which the PLC033 is set, you can have it broadcast the IP and view the results in a terminal program such as Hyper Terminal. This may be necessary if you've forgotten the PLC033's IP. The only solution in that case is to either have the PLC033 broadcast its IP or reset the PLC033 to its factory default state (see Reset PLC033 to Factory Default State on page 36).

1. Power down the PLC033 by turning off the Power Supply Module (PSM).
2. Remove the module from the backplane and place a jumper on pin JP7 FACTORY.



3. Using a service cable, connect a laptop to the PLC033's service port.
4. Start a terminal program session (e.g., Hyper Terminal).
   - Bits per second = 38400
   - Data bits = 8
   - Parity = None
   - Stop bits = 1
   - Flow control = None
5. With the jumper in place, power up the PLC033. Observe the status LED. The blinking pattern will be 8 quick flashes followed by a pause to indicate the PLC033 has been started in reset mode.

(continued on next page)

IMPORTANT: Do not remove the jumper while the PLC033 is powered. This will result in the PLC033 being reset to its factory default state. All configurations will be deleted and the IP address will be reset to 192.168.1.10.

6. The PLC033's IP address should be displayed on the terminal program's screen along with the message "Reset to Factory Default on Jumper Removal."
7. When the PLC033's IP address has been verified, power down the PLC033 and then remove the jumper.

RESET PLC033 TO FACTORY DEFAULT STATE

It is possible to reset the PLC033 to its factory default state. When this is done, all of the configurations, including the ladder program, are deleted and the PLC033's IP is reset to the default IP address of 192.168.1.10.

1. Power down the PLC033 by turning off the Power Supply Module (PSM).
2. Remove the module from the backplane and place a jumper on pin JP7 FACTORY.

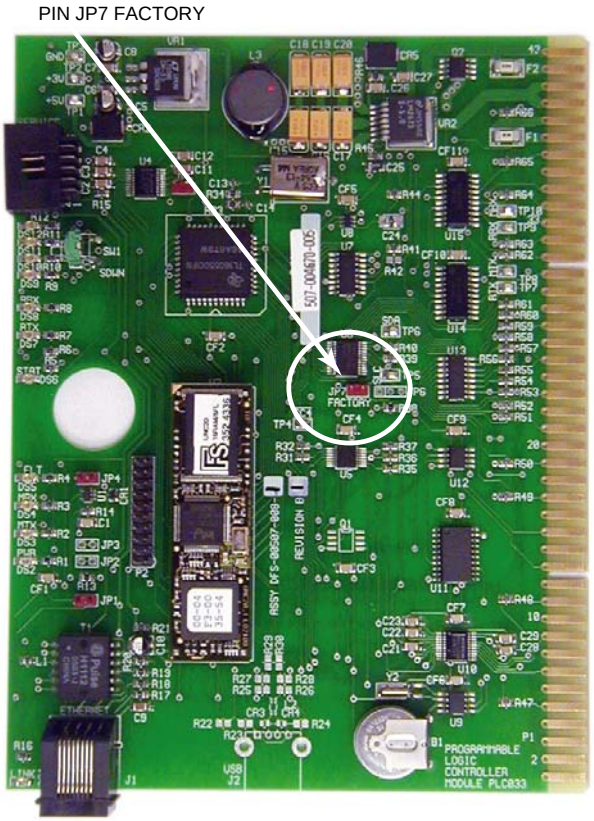


Figure 5-5, Pin JP7 FACTORY

3. With the jumper in place, power up the PLC033. Observe the status LED. The blinking pattern will be 8 quick flashes followed by a pause to indicate the PLC033 has been started in reset mode.
4. Remove the jumper with the PLC033 still powered. Observe the status LED. The blinking pattern will be 5 quick flashes followed by a pause to indicate the PLC033 is going through the reset process. The LED will turn off for approximately 30 seconds and then will return to its normal blinking pattern (slowly turns on and then off).
5. Using a crossover cable, connect a laptop to the PLC033. (You may need to change the network settings for your computer so that it is on the 192.168.1 network. For example, set the computer to 192.168.1.101). Issue a PING command to the factory default IP (192.168.1.10) to verify that the factory default reset was successful.

CONTROLLED SHUTDOWN OF PROCESS (LADDER)

There are several ways to stop the PLC033's ladder:

- Battery voltage drops below 11.2 volts
- PLC033's Shutdown button is pressed for several seconds
- Remote Process Stop Command register (Special Function Register 9921) is set to true via logic (this could be a control on HyperTAC II that sets the register over the radio, or a condition in the PLC033's own ladder that prompts the ladder to set the register itself, or a switch wired to the PLC033's card edge).

In all cases, the ladder is given 30 seconds to perform any actions necessary to put the station in a safe state and set the Remote Process Running register (Special Function Register 9930) to false. When the PLC033 sees that register 9930 is false, it will stop running the ladder in preparation for a physical shut down (e.g., power to the PLC033 is turned off). If the 30 second timer expires before the ladder sets register 9930 to false, the PLC033 will set the register itself and stop running the ladder.

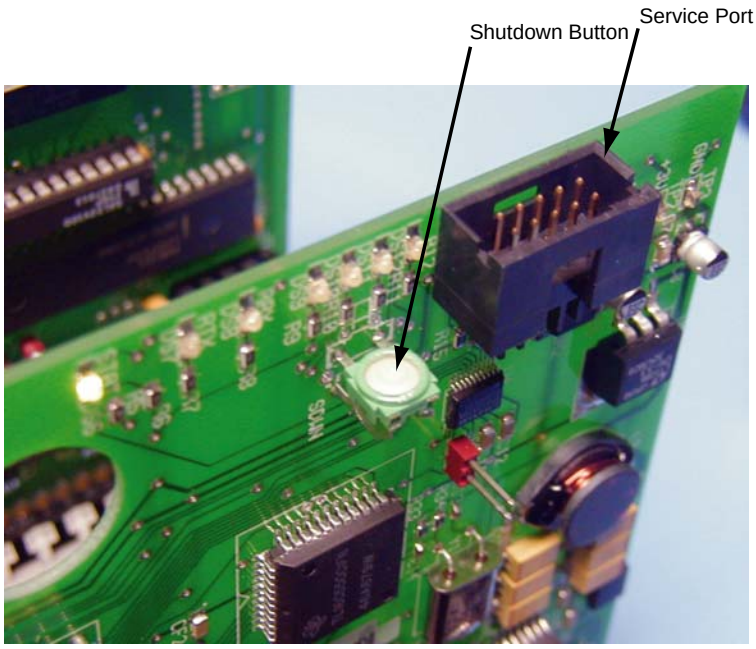
LOW BATTERY VOLTAGE

The PLC033 is designed to monitor the RTU's battery voltage. If it senses that the voltage has dropped below 11.2 volts, the PLC033 will set the Remote Process Stop Command register (Special Function Register 9921) to true. The PLC033 will stop running the ladder when one of two conditions occurs: it sees that the ladder has set the Remote Process Running register (Special Function Register 9930) to false or 30 seconds has expired (in this case the PLC033 itself sets register 9930 to false).

When the process stops due to low battery voltage, you will have to restart the ladder by powering up the RTU, since a loss in voltage is likely caused by loss of AC power.

SHUTDOWN BUTTON

The PLC033 features a shutdown button that can be used to stop and start the ladder. The button can be found on the edge of the card just below the service port.



Holding the button down for several seconds sends a signal to the PLC033 to turn on the Remote Process Stop Command register (Special Function Register 9921). The PLC033 will stop running the ladder when one of two conditions occurs: it sees that the ladder has set the Remote Process Running register (Special Function Register 9930) to false or 30 seconds has expired (in this case the PLC033 itself sets register 9930 to false).

To restart the ladder, simply hold down the shutdown button again. This sends a signal to the PLC033 to turn on both the Remote Process Start Command register (Special Function Register 9920) and the Remote Process Running register (Special Function Register 9930). The PLC033 then starts running the ladder again.

LOGIC

The PLC033's ladder can be stopped and started using logic via the Remote Process Special Function Registers:

- Remote Process Start Command – register 9920
- Remote Process Stop Command – register 9921
- Remote Process Running – register 9930

For example, you could create controls on HyperTAC II that were mapped to registers 9920 and 9921. This would allow you to turn a ladder off and on from a remote location over the radio telemetry link. When the ladder sensed that the Remote Process Stop Command register was true, it could initiate

actions to put the station in a safe state for shutdown. The ladder would then be programmed to turn off the Remote Process Running register, which lets the PLC033 know that it is safe to shutdown the ladder. However, if the PLC033 doesn't see that the Remote Process Running register has been turned off within 30 seconds of the Remote Process Stop Command coming on, it will turn off the register and stop the process on its own.

You could also have a section in your ladder that would turn on the Remote Process Stop Command register when a certain condition occurred. The ladder could be restarted by pressing the Shutdown button for several seconds or via telemetry through a control mapped to the Remote Process Start Command register.

ADVANCED TROUBLESHOOTING TOOLS

PMT's Communication Tools (choose Comm Tools from the Tools menu) is a suite of advanced troubleshooting tools for use by DFS Service personnel.

Notes

USING REMOTE DFS I/O IN A LADDER

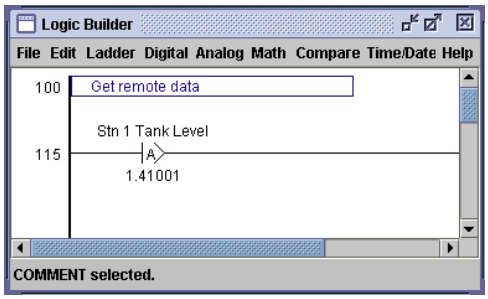
When creating a ladder to control a station or run a process, you may find it necessary to evaluate a condition at another site in order to make a decision. For example, a tank level at station 1 determines when a pump at station 35 goes on.

Getting the information into your ladder requires that you create a "logical" digital or analog input that will hold the value of the I/O from the other station. These objects are by definition inputs to the ladder from either a user or another I/O point.

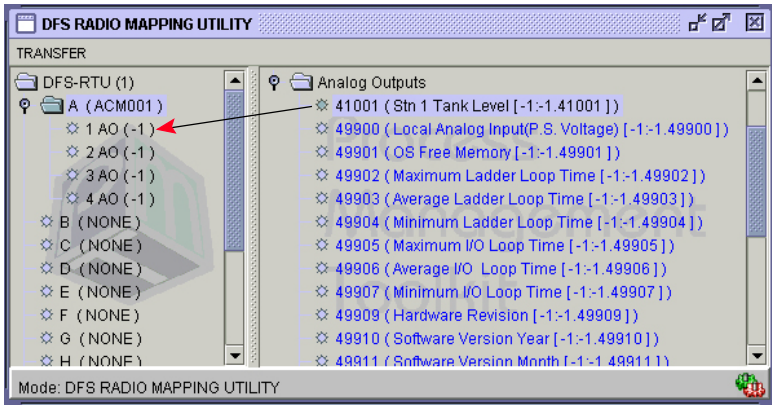
Any I/O point that needs to be directly "writeable" from outside of the ladder must be assigned to the writeable register ranges. As a result, the logical input discussed above must be assigned to an unused register in either the 40001-49999 range (analog) or 1-9999 range (digital).

The logical input created in the ladder must then be mapped to an analog/digital module point in the DFS radio map. An analog/digital output will then be configured in HyperTAC II as an auto control that is controlled by the "real" I/O at the other station.

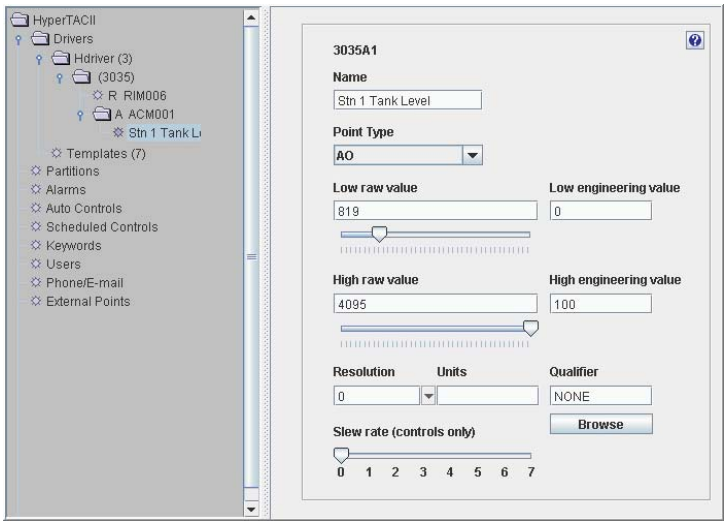
In our example, a logical analog input would be created in the ladder. This logical input would represent the tank level at station 1. It would be assigned to a register in the 40000 range (for example, 41001).



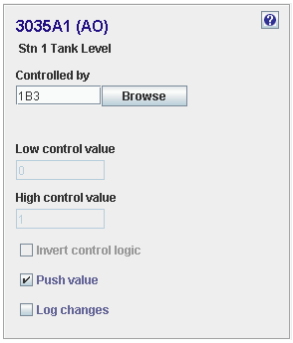
The logical input would be mapped to an ACM module point in the DFS Radio Map.



On the HyperTAC II side, you would create an analog output with an address that matches that given to the point in the radio map. For example, if the point was mapped to module A, point 1, it would have the same address (plus the station number) in HyperTAC II.

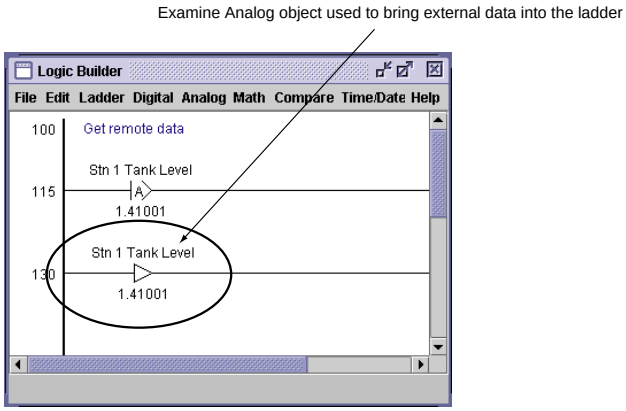


You would then create an auto control for the logical point and use the point at the other station (in our case the tank level at station 1, which has the address 1B3) as the source.



This allows the tank level value to be "pushed" into the AO point in HyperTAC II, which then pushes the value into the PLC's ladder when the logical input is examined.

(continued on next page)



The examined input could be used in a ladder statement that evaluated the level at station 1 and turned on the pump at station 35. For example, "if the tank level at station 1 is less than 25 feet, then turn on the pump at station 35."

Note: The Examine Analog object must be scaled to match the configuration in HyperTAC II.

IMPLEMENT PLC CENTRAL FUNCTION

The PLC Central feature enables the PLC033 to poll remote DFS RTUs in addition to local modules and local Modbus-compatible I/O. PLC Central can be a secondary function of the PLC033 or its primary function. The PLC033's mode is determined by the value of Special Function Register 9951 "Comm 2 DFS Central Mode."

When register 9951 ("Comm 2 DFS Central Mode) is true, the PLC033 functions as a PLC Central and polls all of the I/O configured under the DFS-PLC driver's "Remote" branch. When this register is false, the PLC033 will *not* poll remote modules; it will only poll its local I/O and respond to queries received over the DFS radio link.

As a secondary function (backup mode), the PLC033 can temporarily switch to PLC Central mode when it determines that communications with the HyperTAC II central have been lost. This mode uses two timers that are inserted in the PLC033's ladder logic program. These timers instruct the PLC033 when it should switch to PLC Central Mode (Comm 2 DFS Central Mode is "true") and when it should return to normal operation to check if communications with the HyperTAC II central have been restored (Comm 2 DFS Central Mode is "false").

Special Function Register 49951, "Comm 2 Time Since Last Comm" is a timer (measured in seconds) that monitors how long it has been since communications were received from the HyperTAC II central. If the timer expires, the PLC033 starts operating in PLC Central mode. The second timer is a user-created central mode timer that monitors how long the station has been in PLC Central mode (see line 125 in the ladder on the next page for an example). The second timer tells the PLC to return to normal operation after the specified length of time, so it can check if communications have been restored.

The ladder below presents code that can be used for most PLC Central "backup mode" operations. In this example, the ladder switches modes based on loss of communication from a HyperTAC II central. If register 49951, “Comm 2 Time Since Last Comm” reaches or exceeds 60 seconds, the PLC033’s operation switches to central mode for sixty seconds (lines 115 and 120). When the central mode timer reaches 60 seconds (lines 125 and 130), the PLC033 returns to normal operation mode (register 9951 is reset to “false”) to determine if the central has come back online.

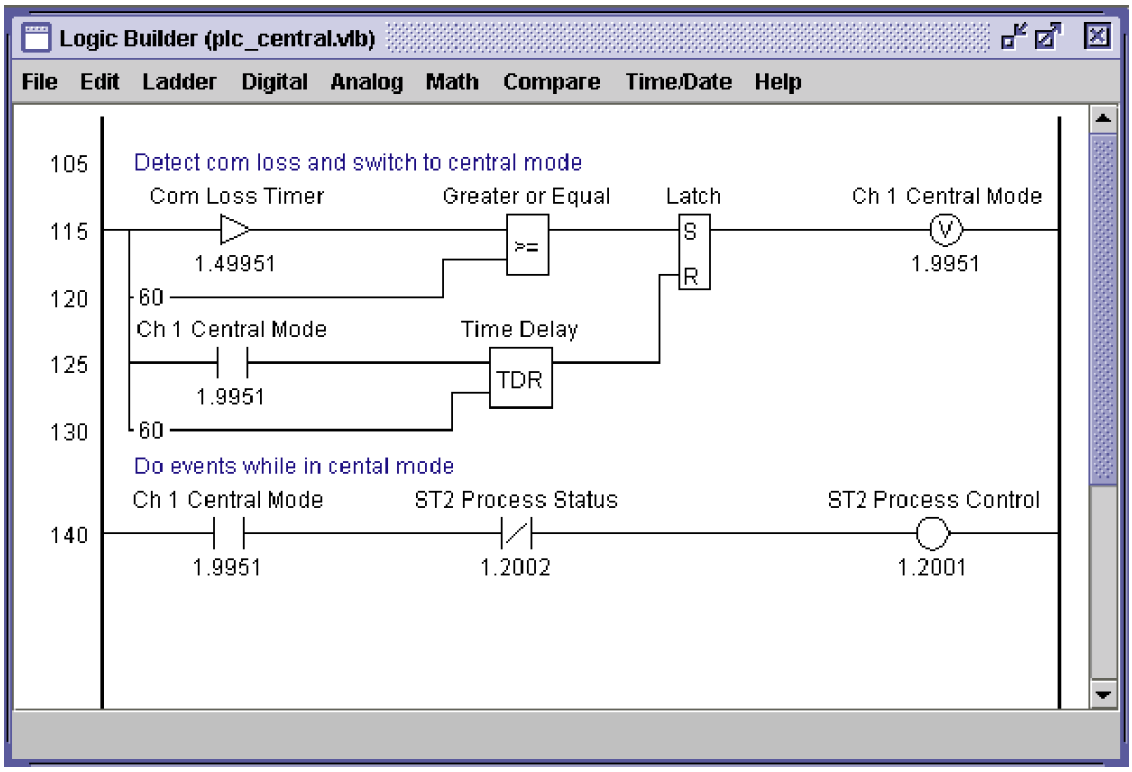
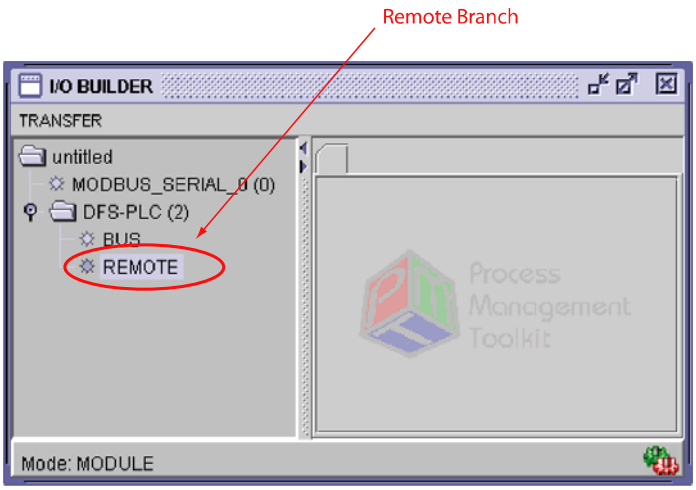


Figure B-1, PLC Central Backup Mode Ladder Code

For RTU systems that require a centralized site for logic, but aren’t large enough to warrant a HyperTAC II central site, the PLC033 can be forced to permanently stay in PLC Central mode by setting and keeping the Comm 2 DFS Central Mode register at a “true” value in the PLC033’s ladder logic program. For example, the first line in the PLC033’s ladder logic program could be written to set the Comm 2 DFS Central Mode register to “true” if power is detected.

(continued on next page)

The remote I/O that the PLC033 is to poll during PLC Central mode operation, must be configured under the “Remote” branch in I/O Builder.



The process of adding DFS modules to the “Remote” branch is similar to the process used when adding modules under the “Bus” branch with the addition of one step – the station number of the RTU where the module(s) to be polled are located must also be specified.

1. Right-click **Remote** and select **New**.
2. In the **New Remote Module** dialog box, enter the station number assigned to the RTU.
3. In the Module Table, select the module’s type from the **Module Type** drop-down menu.
4. Similar to DFS local I/O, remote I/O must also be mapped. Enter valid, unused register numbers in **Start1** (and **Start2** where applicable). To keep things organized, you may want to set aside a group of registers in each Modbus register range that is only used for remote I/O.

Notes

Appendix C: UPDATE PLC FIRMWARE

From time-to-time, we will make updates to the PLC's firmware (the ROM-based software that controls the device). These updates may add new features to the operation of the PLC or may fix bugs in the previous release. When updates are available, they will be placed on our server and can be downloaded and installed on the PLC via the Update command in the Process Management Toolkit.

To update the PLC's firmware, you must be on a computer that has access to the PLC you want to update. An Internet connection is optional but preferable. If you are connected to the Internet, you are ensured of getting the latest firmware updates. Without an Internet connection, PMT will update the PLC with any applicable updates that have been stored locally from a previous download. Files are stored locally in a folder in the main PMT directory.

When you initiate the update process, PMT attempts to connect to our server. After successfully connecting to our server, it compares the files on our server to those stored in the local PMT directory. Any updates not found in the local folder are downloaded. If no Internet connection is found, only the locally stored files will be used to update the PLC. After downloading the updates, the PMT connects to the PLC, compares the PLC's current firmware to the locally stored update files, and then makes the necessary updates.

Firmware updates are typically 1-2Mb, although the file size could be smaller or larger depending on the changes that have been made.

Firmware Update Procedure

Note: If you will be updating more than one RDP, a connection to the Internet is only required for the first device. Once the update files have been downloaded to the PMT folder, you can update the remaining RDP's without being connected to the Internet; they can be updated using the locally-stored files.

1. Start PMT and open the project file for the PLC you want to update.
2. Select **Update PLC/RDP** from the **Network** menu. The dialog box will show the download progress (to the PMT folder).
3. When the updates have finished downloading, a second dialog box will show the file upload progress (to the PLC). When the transfer is complete, click **Done**.
4. Reboot the PLC (cycle power) to finalize the updates.

Notes

FURNISHED PARTS

PLC033

Part No. DFS-00507-008-01

OPTIONAL PARTS

100Base-T Network Surge Arrestor
Part No. 002-0279

Notes

March 7, 2008 Release

New Features

5. The PLC033 can now emulate up to two DFS RTUs. This allows developers to exceed the 15 module maximum for DFS RTUs. This is accomplished in the Radio Map by right-clicking the main branch and selecting Add Remote Device. It is recommended that you choose the next station number after the physical address of the station the PLC is installed in, and that you configure the second station's RIM type as RIM004 in HyperTAC II. (e.g. If the PLC is in RTU #17 then add remote device #18 in the Radio Map). The RTU will now respond as station 17 and 18 in HyperTAC II.
6. The PLC033 and RDP180 now have a configurable Modbus slave device address for serial slave function. This is configured in the settings panel of PMT as the Slave Device #. Prior to this change the PLC/RDP would respond to any serial messaging. This feature allows the PLC/RDP to operate as a serial slave device on 485 or radio networks where there is more than one slave device.
7. System variable addresses can now be obtained from logic builder. This is accomplished by right-clicking the desired object. Previously there was no easy way of determining what address the builder had assigned un-addressed objects in the ladder.
8. The PMT is now the tool used to update the RNA110. This is accomplished by selecting Updated RNA from the Network menu. This works similarly to the update RDP/PLC function. The PMT obtains the update from our FTP server, but it prompts the user for the IP address of the target RNA110 before installing the update.

Fixes

Ladders that had rungs of logic too large to fit on a single page would not print. The printing method was overhauled to correct this and print ladders more efficiently.

9. Analog registers were not being removed and/or recreated in the points list properly. The PMT now performs a complete re-build of the points list each time a ladder check or install is performed. This process is reflected with a “busy” progress bar at the bottom left of the PMT status bar.
10. Q Points were not being properly added to the logic file. This fix only applies to the PLC033.
11. A scaling error was corrected for analog points on the screen builder.
12. A math error was corrected with the flow totalizer object.
13. A condition that caused the PLC/RDP to intermittently crash when used as a Modbus TCP slave device with HyperTAC II was corrected.

Notes

Appendix F: SUPPORT, SERVICE, AND WARRANTY

SUPPORT AND SERVICE

Data Flow Systems, Inc. offers support services nationwide from its home office and through authorized Value Added Resellers (VARs) and System Integrators. Contact your local Data Flow Systems, Inc. representative for:

- Sales and order support
- Product technical training
- Warranty support
- Support service agreements

If you are unsure of whom to contact, call DFS' Melbourne headquarters at 321-259-5009 and ask for the Sales Department. Alternatively, send email to sales@dataflowsys.com.

TECHNICAL PRODUCT ASSISTANCE

Please review the information in Appendix A: Testing and Troubleshooting, before contacting Data Flow Systems, Inc. If you need further assistance, contact your local Data Flow Systems representative. If you are unsure of whom to contact, call DFS' Melbourne headquarters at 321-259-5009 and ask for the Service Department. Alternatively, send email to service@dataflowsys.com.

RETURN AUTHORIZATION (RA) PROCEDURE

Data Flow Systems' function modules are designed to be robust and highly reliable. We back this performance with a 3-year full warranty (see our warranty statement for details). In the event that a function module fails, during or after the warranty period, it may be returned to Data Flow Systems to be repaired or replaced.

All RA's will be subject to standard shipping and handling charges. Minimum handling charge will be assessed, in most cases, for work such as Radio Tuning, Backplanes, "No Problem Found," and other minor repairs. Handling charges will be waved on warranty equipment. Standard shipping and charges will be based on UPS ground, please advise if other arrangements are needed (UPS Red, FedEx, Pickup, Freight…). Standard cost of repairs and shipping charges can be obtained by contacting our RA Department by phone or e-mail.

STEP 1: Replace the failed module with a spare module of the same type, if one is available.

STEP 2: Contact Data Flow Systems Inc. in one of the following ways to receive an RA#.

E-mail – An RA# can be obtained by e-mailing DFS at rma@dataflowsys.com and must include the following information.

- Customer/Utility Name and Ship to Address
- Contact Name and Phone Number

- Products to be returned and Serial Numbers
- Detailed description of failure
- PO#

Phone – RA# will be issued over the phone by calling DFS at 321-259-5009 during normal operating hours. The following information will be needed.

- Customer/Utility Name and Ship to Address
- Contact Name and Phone Number
- Products to be returned and Serial Numbers
- Detailed description of failure
- PO#

Note: The lack of "Detailed description of failure" could result in the return of equipment due to the inability to properly determine the nature of the failure or testing resulting in "No Problem Found"

STEP 3: Place the function module(s) individually in an electrostatic discharge bag and then wrap with foam or bubble wrap. Pack the wrapped module(s) in a sturdy box filled with popcorn-type or bubble wrap packing material. Include a packing slip with the following information:

- Module(s) model, serial number, probable cause of failure, and the RA number
- Shipping address
- Shipping instructions (shipping costs greater than UPS ground are charged to the customer)

STEP 4: Address the box to:

RA Department # {the RA number you received here}
Data Flow Systems, Inc.
605 N John Rodes Blvd.
Melbourne, FL 32934-9105

STEP 5: Ship the box to DFS using any typical shipping carrier (for example, UPS, FedEx, etc.). If circumstances permit, have a DFS employee hand carry the package to the headquarters for you. **NOTE**: DFS employees are not permitted to hand carry unpacked modules.

Modules are typically repaired and shipped back to the customer within a 2-week period starting at the time the module reaches the RA Department. If additional information is required during the repair of the module(s), the DFS service department will contact you.

To get information on the progress of any of your equipment in for repair, contact the DFS - RA Department at rma@dataflowsys.com or 321-259-5009.

Replacement of equipment may be necessary in the event that the equipment and/or parts are unrepairable. Warranty equipment will be replaced with out prior notification as warranty replacement. The customer will be notified by phone, if equipment not under warranty cannot be repaired, with information of available options.

DFS reserve the right to return any material received without an RA# or not conforming to the requirements of this RA process.

WARRANTY

Data Flow Systems, Inc. (DFS) offers a one (1) year on-site warranty covering defects in materials and workmanship. All DFS "plug-in" function modules, Pump Control Units (PCU), Hyper Server Modules (HSM), Network Interface Modules (NIM), Fiber Interface Modules (FIM), Network Switch Modules (NSM), Network Fiber Modules (NFM), and Back Pack Radios (BPR) carry an extended two (2) year return-to-factory warranty. This extended warranty does not cover misuse, vandalism, or Acts of God. However, these items are warranted against damage due to lightning for the entire three-year period.

NOTICE

The intended purpose of the TCU is telemetry control. Using the TCU for purposes other than telemetry control is not recommended and will void the warranty.

QUESTIONS OR COMMENTS ON THIS MANUAL

If you find a problem with any of the information in this manual or have suggestions on how it could be improved, please contact us at the address below:

Data Flow Systems, Inc.
Documentation Department
605 N. John Rodes Blvd.
Melbourne, FL 32934

Alternatively, e-mail us at:

documentation@dataflowsys.com

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Data Flow Systems, Inc.
605 N. John Rodes Blvd.
Melbourne, FL 32934
321-259-5009
www.dataflowsys.com